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THE CONSTITUENTS OF SOME CUCURBITACEOUS PLANTS.*

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A Contribution from the Wellcome Chemical Research Laboratories, London.

In response to a request to contribute a paper to the Pharmaceutical Conference at Sydney, it has been considered that a somewhat comprehensive survey of the results of some recent investigations pertaining to the constituents of a number of tropical or semitropical plants which are used medicinally would not be without some features of interest to those who are engaged in the practice of pharmacy under the Southern Cross.

The particular plants which have been chosen for present consideration are representatives of the natural order of *Cucurbitaceæ*—the so-called Gourd or Cucumber Family. This natural order has been stated to contain nearly 100 genera, comprising about 500 species, which appear to be pretty equally distributed between the eastern and western hemispheres. Although these plants are chiefly natives of hot countries, such as India and South America, a few are found in North America and the north of Europe, while some are also met with at the Cape of Good Hope and in Australia.

The plants belonging to the family of *Cucurbitaceæ* are particularly characterized by the occurrence in them of acrid or purgative principles, and it is for this reason that a considerable number have been employed to a greater or less extent as medicinal agents. On the other hand, many of the species, when cultivated, yield edible

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and nutritious fruits, such, for example, as the pumpkin and squash, the cucumber, the many varieties of melon, etc.

In considering those plants, or the parts or products of them, which are known or reputed to possess certain physiological properties, attention may specially be devoted to such as have recently been made the subjects of complete chemical investigation in the Wellcome Chemical Research Laboratories, London. In this connection it would appear of interest to note that of the drugs under present consideration, elaterium, pumpkin seed, watermelon seed, and bryony root were recorded in the inventory of a pharmacy at Frankfort-on-Main, Germany, dating from about the year 1450. All of the above, together with colocynth pulp (*Colocynthidis pulpa*), were likewise noticed in the *Dispensatory* of Valerius Cordus, first published in 1546, which affords further evidence that these simple drugs were kept by the apothecaries and used medicinally at a very remote period (compare Tschirch, *Handbuch der Pharmakognosie,* 1910, Bd. I, pp. 576, 798).

Elaterium.

The product known as *Elaterium* is at present recognized by but few of the national pharmacopœias. It is, however, still retained in the British Pharmacopœia, where it is defined as "a sediment from the juice of the fruit of *Ecballium Elaterium,* A. Richard."

The history of this drug indicates it to have been employed in ancient times, for it is recorded (*Pharmacographia,* 2d edit., p. 292) that "Dioscorides explicitly describes (about A.D. 77 or 78) the singular process for making elaterium, which was almost exactly like that followed at the present day." It is also noted in the *Pharmacographia Indica,* Vol. II., p. 96, that "the Mahometan writers attach considerable importance to elaterium as a purgative of the diseased humours which they suppose to be the cause of a great number of diseases."

Although the administration of a drug possessing such drastic purgative properties as elaterium is seldom indicated, its comparatively rare employment in modern medicine is probably also attributable in part to its variable character and consequent uncertainty of action. This difficulty was supposed to have been overcome by the use of the chief crystalline constituent of the drug, the so-called elaterin, which was regarded as its active principle, and has therefore

been officially recognized by both the British and United States Pharmacopœias.

In the course of a recent chemical examination of elaterium [1] some quite unexpected and interesting results were obtained. The material employed for this purpose consisted of the best English elaterium, which conformed in its general characters to the requirements of the British Pharmacopœia. After having isolated the crystalline product known as elaterin, it was subjected to a prolonged process of fractional crystallization, when it was observed not to be homogeneous, but to consist, to the extent of 60–80 per cent., of a substance which is completely devoid of purgative action. This substance which, in its optical behavior, is laevorotatory, is accompanied in the crude elaterin by a substance of apparently the same percentage composition, but which possesses strongly purgative properties and is dextrorotatory. An examination of the crystalline elaterin of commerce, both of English and German manufacture, showed that this likewise was not of uniform composition, but that it varied considerably in its physical characters and consequently in its physiological action, for the latter, as already indicated, depends upon the proportion of dextrorotatory substance present.

With consideration of the results above described, it was subsequently deemed desirable to make a complete examination of the fresh fruits of *Ecballium Elaterium*,[2] especially as a previous investigator [3] had affirmed that elaterin does not exist in the fruit as such but in the form of a glucoside. In the course of this research it was found, however, that the elaterin is present in a free state, and, furthermore, that various other products which had heretofore been regarded as definite constituents of the fruit, such as the so-called prophetin, ecbalin or elateric acid, hydro-elaterin, and elateride, which were mostly amorphous, must have consisted of complex mixtures (compare Gmelin's *Handbook of Chemistry*, vol. xvii (1866), pp. 364–367).

Having ascertained that elaterin as found in commerce, and as recognized by the British and United States Pharmacopœias, is a mixture of two substances, possessing widely different properties,

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[1] Power and Moore, *Pharm. Journ.*, 1909, **83**, pp. 501–504.

[2] Power and Moore, *Journ. Chem. Soc.*, 1909, **95**, pp. 1985–1993. Compare also Moore, *Ibid.*, 1910, **97**, pp. 1797–1805.

[3] Berg, *Bull. Soc. Chim.*, 1897 [iii], **17**, p. 85.

it was evidently important that these substances should receive distinctive names. It was therefore proposed to designate the predominating constituent of crude elaterin, which is laevorotatory, as α-elaterin, and the physiologically active, dextrorotatory constituent as β-elaterin.

On account of the very small proportion of β-elaterin contained in crude elaterin, it has not, as yet, been found practicable to obtain it in a pure state, and, in an undiluted form, it would doubtless be too potent a remedy for medicinal use. On the other hand, it would appear to be possible to standardize elaterin in such a manner as to secure uniformity with respect to the proportion of its physiologically active constituent, and consequent certainty of action when administered in definite doses. This could doubtless be most easily and satisfactorily accomplished by the adoption of such a standard for its specific optical rotation as would insure the presence of a sufficient proportion of the physiologically active β-elaterin.

Colocynth.

Colocynth, or "Bitter Apple," as it occurs in commerce, consists of the dried, peeled fruit, or the pulp of the fruit, of *Citrullus Colocynthis,* Schrader. This fruit has been known and used medicinally from the earliest times, being mentioned in the writings of Theophrast, Dioscorides, and Pliny (compare *Pharmacographia Indica,* Vol. II., p. 61), and its value would appear to be attested by the fact that it is still recognized by all the national pharmacopœias. Under these circumstances it may be considered somewhat remarkable that, until quite recently, so little of a definite nature has been known respecting the constituents of colocynth. It was stated, for example, many years ago by Walz[4] that this fruit contains a bitter glucoside, designated "colocynthin," which, on boiling with dilute acids, became resolved in another amorphous compound, termed "colocynthein," and dextrose. A crystalline, tasteless substance, named "colocynthitin," has likewise been stated to occur in the fruit, but it was not further characterized.

Although in the intervening years colocynth has attracted the attention of several investigators, their results were more or less conflicting, and could not be considered as having satisfactorily elucidated the nature of its active constituents. Thus Henke[5] could

[4] *N. Jahrb. Pharm.,* 1858, **9**, pp. 16, 225; 1861, **16**, p. 10.
[5] *Arch. d. Pharm.,* 1883, **221**, p. 200.

obtain a product corresponding to the so-called colocynthin only in the form of an amorphous powder, and was unable to confirm the statement of Walz respecting its glucosidic character. Johannson,[6] on the other hand, has stated that " colocynthin," when heated with dilute sulphuric acid, yields colocynthein, elaterin, and bryonin, and some color reactions were recorded which were supposed to differentiate these products. More recently, Naylor and Chappel,[7] in an examination of the fruit of *Cucumis trigonus,* Roxb.[8] (*C. Pseudo-colocynthis,* Royle), have taken consideration of the characters of the so-called colocynthin. They were led to conclude that colocynthin is capable of crystallizing, and that it is glucosidic, yielding on hydrolysis, amongst other products, colocynthein, elaterin, and dextrose. Their conclusions were, however, chiefly based on certain color reactions, which are by no means characteristic of the substances they were assumed to identify.

The various discrepancies in the results obtained by the abovementioned investigators may readily be explained, for it is quite obvious that the products described by them did not represent pure compounds, but consisted of more or less indefinite mixtures. With consideration, therefore, of the unsatisfactory state of knowledge respecting the constituents of so important a drug, it was deemed desirable to subject colocynth to a complete examination. The results of the investigation conducted in these laboratories,[9] for which purpose a good quality of Turkish colocynth was employed, may in this connection briefly be noted.

The pulp of the fruit, which, when deprived of the seeds, amounted to 24.5 per cent. of the whole, was completely extracted with hot alcohol, and the resulting extract distilled in a current of steam, when a very small amount of an essential oil was obtained. From the portion of the extract which was soluble in water, the following substances were isolated: (1) a new, crystalline, dihydric alcohol, $C_{22}H_{36}O_2(OH)_2$ (m.p. 285–290°), which has been designated citrullol; (2) an amorphous, alkaloidal principle, which pos-

[6] *Zeitschr. Analyt. Chem.*, 1885, **24**, p. 154.

[7] *Pharm. Journ.*, 1907, **79**, p. 117.

[8] *Cucumis trigonus,* Roxb., which is indigenous to India (compare *Pharmacographia Indica*, Vol. II, p. 65) has been noted by Mr. J. H. Maiden, F.L.S., Director of the Botanic Gardens, Sydney, as being also a native of New South Wales, Queensland, and Northern and Western Australia (*Pharm. Journ.*, 1899, **63**, p. 16).

[9] Power and Moore, *Journ. Chem. Soc.*, 1910, **97**, p. 99.

sesses an extremely bitter taste, and represents one of the purgative principles of the fruit. The aqueous liquid contained, furthermore, a quantity of inorganic salts, a little sugar, and a very small amount of an amorphous, glucosidic substance.

The substance designated citrullol is of special interest, inasmuch as it is a member of a group of dihydric alcohols which form an homologous series, represented by the general formula $C_nH_{2n-8}O_4$. The other known members of this group, which were likewise isolated in these laboratories, are: ipuranol, $C_{23}H_{38}O_2(OH)_2$, which was first obtained from the stems of *Ipomœa purpurea*, Roth,[10] but has since been found to be a constituent of numerous other plants, and trifolianol, $C_{21}H_{34}O_2(OH)_2$, which was first isolated from red clover flowers,[11] subsequently from the flowers of the carnation clover,[12] and quite recently from Calabar beans.[13]

The portion of the above-mentioned alcoholic extract which was insoluble in water consisted chiefly of resinous material, but from it a quantity of α-elaterin,[14] $C_{28}H_{38}O_7$ (m.p. 232°; $[\alpha]_D$–68.9°) was isolated. On subsequently extracting the resin with various solvents, it yielded, furthermore, a small amount of hentriacontane, $C_{31}H_{64}$; a phytosterol, $C_{27}H_{46}O$ (m.p. 160–162°); a mixture of fatty acids, and an additional amount of α-elaterin, together with a little of the above-described alkaloidal principle. The ether and chloroform extracts of the resin possessed marked purgative properties.

The seeds of the colocynth, which amounted to 75.5 per cent. of the entire peeled fruit, were extracted with light petroleum, when they yielded 12.7 per cent. of their weight of a fatty oil. The latter was found to agree very closely in character with the oils from some other cucurbitaceous seeds, such as those of the pumpkin and watermelon, which will subsequently be described. The colocynth seeds also contain a small amount of an enzyme which hydrolyses β-glucosides, and traces of an alkaloidal principle, which is probably identical with that contained in the pulp of the fruit.

The results of the recent research on the constituents of colocynth have, on the one hand, afforded conclusive evidence that the so-called "colocynthin" and "colocynthitin" of previous investigators were

[10] Power and Rogerson, this Journal, 1908, **80**, p. 264.
[11] Power and Salway, *Journ. Chem. Soc.*, 1910, **97**, p. 249.
[12] Rogerson, *Ibid.*, 1910, **97**, p. 1014.
[13] Salway, *Ibid.*, 1911, **99**, p. 2154.
[14] Power and Moore, *Ibid.*, 1909, **95**, p. 1989.

not homogeneous, but consisted of mixtures of a very indefinite character, and that the amount of glucosidic substance contained in the fruit is extremely small. On the other hand, it has been shown that the purgative action of colocynth is due to at least two compounds, one of which is alkaloidal, although a very weak base and apparently incapable of crystallizing or forming crystalline salts, whilst the other source of activity is represented by some principle or principles contained in both the ether and chloroform extracts of the resin. The attempts to obtain the last-mentioned active principles in a more definite state were unsuccessful.

Pumpkin Seed.

The seeds of the common pumpkin (*Cucurbita Pepo,* Linné) are chiefly of interest on account of their reputed value as a tænifuge, and it is evidently for this reason that they have long been officially recognized by the United States Pharmacopœia. Although the seeds are usually administered in the form of the bruised kernels, in doses, for an adult, of 100 to 200 grammes, their action has been variously attributed to both the fatty oil and the resin which they contain. In order to ascertain whether any definite active principle is present in the seeds, they were subjected to a complete chemical examination,[15] and the products, so far as practicable, submitted to physiological or clinical tests.

The kernels of the seed yielded, on expression, an amount of fatty oil equivalent to 19.3 per cent. of the weight of the entire seed. When, however, the entire seed were ground, and extracted with light petroleum, the yield of oil amounted to 34.3 per cent. of their weight. This fatty oil, which, when viewed in layers of moderate thickness, had a cherry-red color with a marked fluorescence, was found to consist of the glycerides of linolic, oleic, palmitic, and stearic acids, together with a very small amount of a phytosterol, $C_{27}H_{46}O$. The resinous material, as extracted from the press-cake, amounted to only about 0.5 per cent. of the weight of the entire seed. Neither the fatty oil, in amounts of 15 to 60 c.c (about half a fluidounce to two fluidounces), nor the resin, in amounts of 1 gramme (representing about 200 grammes of the seed), were found to effect the complete removal of tape-worm, when administered to different individuals under the usual conditions of fasting and followed by a dose of castor oil.

[15] Power and Salway, *Journ. Amer. Chem. Soc.*, 1910, **32**, pp. 346–360.

In view of the above-mentioned results, and the fact that pumpkin seed contain no principle which exhibits marked physiological activity,[16] it could only be concluded that any value which they may actually possess as a tænifuge, when administered in substance, must be attributable to a mechanical action. In any case, the remedial value of pumpkin seed cannot be considered such as to justify their recognition by a national pharmacopœia.

Watermelon Seed.

The seeds of the common pumpkin having been subjected to a complete chemical examination, as already noted, it was deemed desirable also to examine those of the watermelon (*Cucurbita Citrullus,* Linné),[17] since the latter have been employed to some extent medicinally on account of the diuretic properties attributed to them, although chiefly as a domestic remedy.

Nothing, hitherto, appears to have been known respecting the constituents of watermelon seeds beyond the fact that they contain a fatty oil, of which the physical and chemical constants have been recorded, as also those of the mixed fatty acids obtained therefrom (compare Lewkowitsch, *Chemical Technology and Analysis of Oils, Fats, and Waxes,* 3d edit., Vol. II., p. 511).

The kernels of the seed yielded, on expression, an amount of fatty oil equivalent to 7.4 per cent. of the weight of the entire seed. When, however, the entire seed were ground, and extracted with light petroleum, they yielded 19 per cent. of oil The expressed oil, unlike that from pumpkin seed, possessed a yellow color, and was completely devoid of fluorescence. On the other hand, the physical and chemical constants of watermelon seed oil approximate very closely to those of pumpkin seed oil. As might, therefore, be expected, the two oils are very similar in composition, consisting, as noted in connection with pumpkin seed oil, of the glycerides of linolic, oleic, palmitic, and stearic acids.

From the press-cake an amount of resinous material was obtained corresponding to about 0.3 per cent. of the weight of the entire seed. This resin was found to exhibit no physiological activity

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[16] The expressed oil of pumpkin seed is largely used for culinary purposes in Austria, Hungary, and Russia (compare *Journ. Soc. Chem. Ind.*, 1898, **17**, p. 1054, and Lewkowitsch, *loc. cit.*, p. 509), whilst the press-cake has been recommended as a food for cattle (Hager's *Handbuch,* 1900, Bd. I, p. 978).

[17] Power and Salway, *Journ. Amer. Chem. Soc.*, 1910, **32**, pp. 360–374.

when administered to a dog in doses of 1 gramme. A chemical examination of the resin led, however, to some results of interest, inasmuch as it yielded, besides a little phytosterol, a new crystalline alcohol, $C_{24}H_{40}O_4$ (m.p. 260°), which has been designated cucurbitol. This compound will be further noticed in connection with the constituents of bryony root.

Bryony Root.

Bryony root has been used medicinally from a very remote period on account of its purgative properties (compare Tschirch, *Handbuch der Pharmakognosie,* 1910, Bd. I, pp. 576, 798). It was formerly recognized by several of the national pharmacopœias, including that of the United States, but was omitted from the latter in the eighth revision (1900), and is now rarely employed. The plants yielding this root are *Bryonia alba,* Linné, and *Bryonia dioica,* Linné, both of which are indigenous to the greater part of Europe, but the last-named species is the only one commonly found in England, and, therefore, is frequently designated English bryony.

Bryony root has previously been the subject of several investigations, chiefly for the purpose of determining the nature of its active constituent (compare Husemann, *Die Pflanzenstoffe,* 2d edit., p. 1349, and van Rijn, *Die Glykoside,* p. 463), but until quite recently [18] no complete examination had been made of it. According to the earlier investigators, the root contains an amorphous, bitter glucoside, designated as bryonin. As obtained by Masson,[19] this product was stated to possess the formula $C_{34}H_{48}O_9$, and, on heating with dilute sulphuric acid, to become resolved into dextrose and an amorphous, yellow resin, termed bryogenin, $C_{20}H_{38}O_4$. Another product obtained by Masson, which was of a purely resinous nature, was named bryoresin, and to this the formula $C_{37}H_{68}O_{18}$ was assigned. A consideration of the method of preparation and characters of the above-mentioned products, as described in the literature, renders it evident, however, that they could not have represented pure or homogeneous substances.

The material employed for the investigation conducted in these laboratories consisted of the roots of *Bryonia dioica,* Linné, which had been specially collected in districts near London, under the

[18] Power and Moore, *Journ. Chem. Soc.,* 1911, **99**, pp. 937–946.

[19] *Journ. Pharm. Chim.,* 1893 [v], **27**, 300.

supervision of a competent botanist. The details of this investigation have already been recorded (*loc. cit.*), and therefore only a brief summary of the results obtained need here be given.

The amount of fresh root collected was 107.5 kilogrammes, and this, after being sliced and dried, weighed 25.5 kilogrammes, the loss on drying having thus been equivalent to 76.3 per cent. of the original weight.

The root was found to contain an enzyme, which was obtained in the form of a light brown powder. This product slowly hydrolysed the glucosidic constituent of the root, and also effected the hydrolysis of amygdalin and salicin.

For a complete examination of the constituents of the root, 23.9 kilogrammes of the dried and ground material were extracted with hot alcohol. The resulting extract, when distilled in a current of steam, yielded a small amount of a pale yellow essential oil. From the portion of the extract which was soluble in water there were isolated: (1) a small amount of a colorless, crystalline, neutral substance (m.p. 220–222°), which appears to possess the formula $C_{20}H_{30}O_5$; (2) an amorphous, glucosidic product, having a brown color and a bitter taste; (3) an amorphous, alkaloidal principle, possessing a brownish-yellow color and an intensely bitter taste. The aqueous liquid contained, furthermore, a quantity of sugar, which yielded *d*-phenylglucosazone (m.p. 208–210°).

The portion of extract which was insoluble in water consisted of a dark brown, viscid resin, amounting to about 2 per cent. of the weight of dried root employed. From this resin the following compounds were isolated: (1) a phytosterol, $C_{27}H_{46}O$ (m.p. 137°), which was optically inactive; (2) a new dihydric alcohol, bryonol, $C_{22}H_{34}O_2(OH)_2$ melting at 210–212°; (3) a mixture of fatty acids, consisting of oleic, linolic, palmitic, and stearic acids.

The compound designated as bryonol is of particular interest, inasmuch as it belongs to a group of dihydric alcohols which form an homologous series, represented by the general formula $C_nH_{2n-8}O_4$. The other known members of this group, all of which were isolated in these laboratories, are as follows: ipurganol, $C_{21}H_{32}O_2(OH)_2$, from jalap resin;[20] grindelol, $C_{23}H_{36}O_2(OH)_2$, from the resin of *Grindelia camporum*, Greene;[21] and cucurbitol, $C_{24}H_{38}O_2$

[20] *Journ. Amer. Chem. Soc.*, 1910, **32**, p. 89.
[21] *Proc. Amer. Pharm. Assoc.*, 1907, **55**, p. 342.

$(OH)_2$, which, as already noted, was obtained from the resin of watermelon seed.[22]

In the course of the recent investigation of bryony root it was ascertained that both the above-mentioned glucosidic product and the alkaloidal principle, as well as the aqueous liquid from which they had been removed, were abundantly precipitated by tannic acid. It follows, therefore, that the preparations obtained by previous investigators by means of this reagent, which were regarded as a glucoside, and designated "bryonin," must have consisted of complex mixtures, the constituents of which, moreover, were not entirely glucosidic. The various chemical formulæ that have been assigned to these amorphous compounds are accordingly quite fallacious.

Physiological tests conducted with the above-mentioned products have rendered it evident that the activity of bryony root cannot be attributed to a single definite principle. Its purgative property appears to reside chiefly in the resinous and alkaloidal constituents; the crystalline principle, $C_{20}H_{30}O_5$, and the glucosidic product having been found to be quite inactive when administered to dogs in doses of 0.1 gramme. The assumption of previous investigators that the active principle of bryony root is a glucoside, has thus been shown to be incorrect.

In conclusion it may be noted that there are a number of other cucurbitaceous plants besides those here considered which, on careful chemical examination, would doubtless be found to possess constituents of interest. On the other hand, it is apparent that the plants of this family represent but a very small part of the field of organic *materia medica* which still remains to be explored.

TRAGACANTH—ITS SOPHISTICATION WITH ANOTHER GUM.

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The substitution and adulteration of powdered tragacanth, with a substance known to the trade as Indian gum, has been practiced for several years, beginning about 1904–1905, and has assumed large proportions. It is a profitable line and works severe hard-

[22] *Journ. Amer. Chem. Soc.*, 1910, **32**, p. 367.

ships on the dealer in true tragacanth, because the unpowdered spurious gum is imported at a price several times cheaper than the grades of tragacanth used for powdering, and when powdered it is sold at a handsome profit, yet at a figure low enough to prevent competition from tragacanth. It costs the importer 4–10 cents per pound, depending on the quality, and tragacanth costs from 25–80 cents per pound.

Tragacanth gum is obtained from the shrubs of the Astragalus genus, the gum bearing species yielding products which resemble one another closely in physical and chemical characteristics. There are several gums known as Indian gum, but none of these are obtained from any species of Astragalus. The name *kuteera*, *katirah* and the same with many other spellings, has been applied to some of the Indian gums and to certain of the Astragalus products, the gums from A. heratensis and A. strabilifera, and it has no special significance and does not indicate the origin or proper classification of the gum. While it is possible that the Indian gum used so extensively in this country may vary as to its origin, the specimens examined in the whole condition correspond with samples of gum Sterculia urens submitted directly from India and from London. Furthermore, in a private report submitted from Bombay it is stated that S. urens is the source of this gum, and that it is used as a substitute for tragacanth in the government hospitals in Bombay.

True tragacanth is a product of Turkey, Asia Minor and Persia, the Syrian or Aleppo tragacanth is exported principally from towns on the coast of Syria, such as Beirut, the Persian gum sometimes comes through this port, but is generally shipped down the Tigris and thence eastward, through the Persian Gulf, the Turkey tragacanth is shipped from Smyrna and Constantinople. All of these varieties reach the Hamburg and London markets, and while some shipments are made direct, most of the gum comes from these two ports to the United States. It has been received in small amounts from India, but it is probable that even this gum had its origin in Persia.

The substitute gum in the whole condition has none of the physical characteristics of tragacanth. It occurs in striated irregular lumps, sometimes twisted, transparent or transulcent and not in ribbony bands like tragacanth. As it reaches this country it often contains considerable bark which is bolted out before the powdered material is ready for the market. The powder is usually

very white, rivalling in appearance that of the best grades of tragacanth. The bark contains characteristic stone cells which pass into the powder, and serve as a means of identifying the source of the product. Tragacanth bark contains no substance of similar character.

If the product is a straight substitution there is little difficulty in distinguishing it from pure tragacanth. The powder of the spurious article forms a nearly transparent jelly with water, swelling up to a considerable bulk and apparently dissolving, though, as a matter of fact, a small portion only is taken into solution. The aqueous mixture is decidedly acid to litmus. It is unaffected by iodine solution which becomes blue in the presence of true tragacanth, and it does not give a yellow color when warmed with alkali; in fact, when there is a straight substitution and no added starch, the pharmacopœial tests for tragacanth will indicate the fraud. When an aqueous mixture of this gum is boiled with dilute hydrochloric acid, a clear solution with a marked pink color results, tragacanth under like treatment dissolves only in part, a large mass of flocculent material settles out, leaving a brown supernatant liquid. In the case of a mixture of this gum with tragacanth, the examination becomes more complicated, for such a product will answer the pharmacopœial chemical tests for tragacanth, and one has to resort to other reactions in order to determine the character of the original material before it was powdered. In admixtures of this type the microchemical test will indicate the presence of the spurious gum, even when the proportion is quite small. Indian gum reacts in a peculiar manner with borax, referred to at some length by Scoville,[1] which property is of value in detecting mixtures. Tragacanth gives a smooth creamy mixture while the substitute gives a thick slimy mass, often so gelatinous that it will not pour out of the container, this property being apparent even in presence of considerable amounts of tragacanth. The test is best performed by placing 2 grams of the powder in a 100 c.c. graduated cylinder, moistening with alcohol and adding about 50 c.c. water, shaking until an homogenous mixture is obtained; 2 grams of borax are dissolved in 50 c.c. water, added to the jelly; the whole well shaken and allowed to stand over night. When pure tragacanth alone is under examination, the resulting mixture will pour out of the cylinder without stringing, while if Indian gum is present a stringy mixture results. Another important property of the new gum is the separation of volatile acids, largely acetic, on

[1] Druggists Circular 1909, 116-17.

boiling with mineral acids; tragacanth, treated in the same way gives a distillate which is slightly acid, but the amount is much smaller than that obtained with Indian gum. It has been found that the amount of acid given off by specimens of Sterculia urens collected at random is quite constant, and the acidity of a sample under examination will furnish a very reliable figure for estimating the amount present.

THE RESULTS OF THE EXAMINATION OF FORTY-SEVEN SAMPLES OF OLIVE OIL.

By J. R. Rippetoe and N. Smith.

The determination of the iodine number of olive oil affords one of the best tests for the establishment of its purity The results of the examination of 47 samples will no doubt be of interest since the iodine number of many of the samples was found to be below 80; the U. S. P. requirement being not less than 80 nor more than 88. Otherwise the samples complied with the requirements and were considered of good quality for medicinal or edible purposes with several exceptions where the amount of free acid was high.

No appreciable difference in the results was obtained by varying the excess of iodine, time of standing (4 to 16 hours) and temperature.

All determinations were made in duplicate, the mean reported, and if there were variations of more than 1.0 another assay was made. Eight ounce Erlenmeyer flasks with rubber or cork stoppers (cork preferred) were used and found more satisfactory than glass stoppered flasks.

Sample No.	Marks or source.	sp. gr. 25/25° C.	Sap. No.	Iod. No.	Free Acid as oleic per cent.
3689		.9113	192.5	82.4	
3690		.9114	191.5	78.8	
3691		.9115	190.5	78.6	
3704	Italian, Lucca	.9126	191.0	81.1	0.80
3710		.9114	191.3	80.7	10.00
3747		.9121	189.0	80.0	
2539	Candia, Trieste	.9119	190.4	78.4	3.2
4011		.9116	192.6	80.4	
4064		.9118	195.2	80.6	10.7
4064½	Corsican	.9124	194.5	83.9	0.86

6233	Italian, Lucca	.9115	192.0	81.0	
7578		.9110		84.5	1.36
7697		.9112	191.4	81.3	
7698	Italian	.9117	192.7	81.5	
7858		.9119	192.0	77.9	
8169		.9121	191.9	78.6	
8182		.9115	192.2	77.4	
8216	Extra Cream Salad	.9121	191.7	83.5	
8217	Italian, Lucca	.9122	192.2	84.4	
8479		.9116	193.8	82.7	0.96
8480		.9116	193.6	83.6	2.17
8481		.9111	194.7	86.0	5.49
8482	Italian, Lucca	.9111	193.6	85.3	1.38
8535	Italian, Lucca	.9124	193.5	81.9	1.67
8848		.9106	190.7	80.2	
9689		.9123	191.4	89.4	
9696		.9120	191.7	84.3	
9727		.9114	192.7	80.5	
9728		.9113	191.5	80.5	
9729	Spanish	.9116	190.8	80.4	1.05
9730	Spanish Virgin	.9116	191.3	80.6	1.55
9731	Italian, Lucca	.9114	190.3	80.0	1.61
9788		.9106	191.4	79.0	2.87
9789		.9109	191.6	77.6	1.18
9803	Italian	.9105	191.7	77.7	2.47
9806	Turkish	.9109	192.2	78.5	0.59
9818	Italian, Lucca	.9112	191.4	79.1	1.14
9928		.9134	191.9	81.1	1.11
9874		.9129	194.7	81.0	0.87
9875		.9124	191.0	80.9	1.13
9876	French	.9120	189.6	81.2	0.96
9885	Italian, Lucca	.9118	190.4	79.5	1.00
9886	Italian	.9119	192.0	80.0	1.23
9887	"	.9111	190.9	80.5	1.24
9947	"	.9111	192.4	77.2	0.73
9948	"	.9111	191.2	77.4	1.92
9973	Spanish	.9117	192.2	81.2	1.10

Iodine number, minimum 77.4; maximum 89.4; average 80.9.

We are of the opinion that the limit 80 is too high, and that oils of the best quality may be condemned if held to this requirement. We believe it advisable to establish a limit for free acid (calculated to oleic) in the U. S. P.

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PURIFIED CARAMEL AND THE STANDARDIZING OF CARAMEL SOLUTIONS.[1]

By George M. Beringer.

The desire of the committee engaged in the revision of the National Formulary, to provide for preparations of uniform color wherever prepared if made in accordance with the Formulary recipes, has occasioned considerable study. This problem has been especially referred to a subcommittee on color standards whose reports have aroused considerable interest among those outside of the committee as well as the members thereof.

The colorings most commonly used by pharmacists in elixirs, syrups, etc., at the present time, are caramel and cudbear. The attempt to standardize such indefinite substances has not proven an easy task and while a number of methods have been proposed, opinion has not yet crystallized into a conclusion that any of those proposed has entirely and satisfactorily solved the problems.

In the present communication the writer will confine himself to the consideration and review of the various propositions relating to caramel and leave the consideration of the problems relating to cudbear for another occasion.

Caramel is a complex mixture of a number of organic compounds produced by heating sugars to a temperature high enough to produce dark brown colorings without charring and, after the tumefaction has ceased, adding water. It is believed that it is now produced on the commercial scale entirely from starch sugar or glucose.[2] For the purpose of this communication it is unnecessary to enter into a detailed discussion of the chemistry of caramel. It is sufficient to state that it contains several coloring substances, an odorous principle separable by distillation, usually some undecomposed sugar, and a trace of caramelan, a highly hygroscopic substance having a bitter taste and colorless when pure and varying proportions of water. The gravity usually ranges between 1.300 and 1.390; according to Wagner, the manufacturer usually aims at 35° Baume =

[1] Read before the Philadelphia Branch of the American Pharmaceutical Association Tuesday evening, February 6, 1912.

[2] For details of the commercial methods of manufacturing Caramel see Frankel's translation of Wagner's work on Starch, Glucose, Starch Sugar, etc.

1.312 at 15° C. The ash is usually quite small, rarely over 10 mg. per gram, and this commonly consists of sodium salts, chloride, sulphate and carbonate.

On heating sugars to the temperature necessary to produce caramel several dark colored bodies are produced, some of which are soluble and others insoluble in either water or alcohol, and at least one of these colored substances so produced requires for solution the presence of alkali or alkali carbonate and for this reason the manufacturer adds sodium carbonate or ammonium carbonate or ammonia in the process of manufacture. There is also usually produced a small amount of a brown colored lustrous substance not soluble in any of these solvents.

The writer has recently attempted to review and test out the various suggestions that have been offered as a means of standardizing caramel and its solutions. This work has led him into experiments along certain lines not covered by the other investigators.

One of the first propositions made was, that in order to obtain uniformity, the pharmacist should prepare his own caramel and formulas for this purpose were proposed. The initial proposition presented in the *Bulletin of the American Pharmaceutical Association,* December, 1909, page 479—"is to heat 1 pound of Sugar on the sand bath at 180° C. for 2 hours and dilute it to 1 pint." All of the authorities are agreed that on heating sugar to this temperature and cooling there is formed the allotropic modification of cane sugar known as "barley sugar." However, I tried the suggestion and, as was to be expected, obtained a mass with scarcely any darkening and which could in no way be considered as caramel.

A later suggestion offered (Bulletin of N. F. Committee No. 31—page 364) was "sugar 1000 Gm., water a sufficient quantity. Heat the sugar in an appropriate vessel on a sand bath at 200° C. for 2 hours. Then add to the caramelized fluid enough boiling water to make the finished product measure 1000 c.c." This product was to be standardized by requiring that—"1 c.c. of this diluted with 399 c.c. of distilled water should have the same intensity of color as the Standard Caramel Testing Solution." The standard test solution was Stevens' Standard which will be referred to later. The adjustment of the caramel to the standard was obtained by either dilution or concentration whichever was required.

A test of this method showed that it did produce more or less caramel, but that for the complete caramelization of the sugar a

somewhat higher temperature 210° to 215° was necessary. The resulting product was treated with several portions of boiling distilled water, the solution filtered and concentrated to the volume directed in the formula and this compared with a good commercial sample of caramel was deficient in tinctorial power and had to be further concentrated to obtain a liquid comparing with the standard proposed. The residue on the filter and in the dish was then washed with a warm weak solution of sodium carbonate and this yielded a dark brown solution of the coloring insoluble in the water alone.

A practical difficulty arises in carrying out this formula for caramel. On heating sugar to the temperature necessary odorous vapors and fumes are given off that fill the entire building and unless made under a hood connected with a good draught the manufacture of caramel would be impracticable and the average pharmacist could certainly not make it satisfactorily or economically. The resulting product as made on the small scale by different individuals will also vary considerably in composition.

There is still another phase of the subject that must be considered. If the National Formulary introduces a formula for Caramel, then that formula even though it is not in keeping with the commercial process becomes the legal formula and the product, even though inferior, becomes the legal standard for all caramel. This might prove a very serious source of annoyance and trouble to other industries in which the consumption of caramel is vastly greater than in pharmacy. For this reason I am constrained to believe that the proposition that the N. F. should introduce a formula for Caramel and that the pharmacist should prepare his own is untenable.

For Tincture of Caramel a formula has been proposed in the Bulletin of the N. F. Committee No. 31—page 365—to be made as follows:

"Caramel ....100 gm.
Alcohol and water....................each a sufficient quantity.

"Dissolve the Caramel in such quantity of Alcohol 1 volume and Water 3 volumes as may be necessary so that 1 c.c. of the tincture when diluted with Water to 100 c.c. shall have the same depth of color as a standard solution prepared in accordance with the Stevens' Standard Caramel Testing Solution." The standard test solution proposed by Professor Stevens is as follows:

"Place 0.5 Gm. sugar in a dry test tube 20 mm. diameter. Immerse the tube to a depth of 5 cm. in a sulphuric acid bath, previously heated to 210° C. and keep at that temperature for 20 minutes. Remove the tube and when cold dissolve in sufficient water to make 200 c.c. Add 50 c.c. alcohol and sufficient water to make exactly 250 c.c."

Several of the members who experimented with this formula claim that concordant results were not always obtained and that the width of the test tube and the degree of immersion in the bath as well as the quality of sugar used materially altered the results. The objections to sulphuric acid as a bath was met by a suggestion from Mr. Otto Raubenheimer that a bath of petrolatum be substituted therefor. As a result of my experimenting with this formula following out carefully the directions as to the amount of sugar, size of test tube, etc., I was enabled to obtain fairly uniform results. I prefer, however, to use a cotton seed oil bath to either sulphuric acid or petrolatum. On carrying out this test strictly in accordance with the instructions and attempting to dissolve the caramel in water it was found that the mass clung tenaciously to the test tube and was removed with difficulty. Further, that it was not entirely soluble in water. The insoluble portion was collected on a tared filter, dried, and weighed 145 mg. of residue insoluble in water. On heating this residue with a mixture of 10 c.c. Sodium Carbonate test solution and 90 c.c. of Distilled Water there dissolved out 75 mg. and I obtained a brown solution much darker in color than the original standard test solution. On making this up to the same bulk and then standardizing against the standard in Nessler tubes this was found to be 1.5 times as strong as the original standard. There still remained on the filter a portion of dark brown scales of colored material that was not soluble in either water, alkali solutions, alcohol or ether. These experiments were repeated with but very slight difference amounting to only 5 mg. of residue insoluble in water and the resulting fluids were practically identical in color.

Stevens' Standard Caramel Testing Solution is subject to the criticism that it not only involves considerable time and routine on the part of the pharmacist, but still more, that it does not represent the entire caramel as the stronger portion of the caramel coloring, that requiring alkali for solution, is not taken up and his solution consequently represents only a part of the caramel.

Dr. George A. Menge (American Journal of Pharmacy—

March, 1911—113) has criticized the Stevens' process for standard caramel test solution and has recommended in place thereof a test solution made as follows:

"Make a sulphuric acid solution by adding 2 c.c. of pure concentrated sulphuric acid (specific gravity 1.84) to 12 c.c. of water. Take 0.5 Gm. of sugar in a test tube—add 5 c.c. of the acid solution described above, and heat the mixture in a boiling water bath, with mixture continually submerged and with constant agitation, for exactly 5 minutes. Immediately add a little cold water and then 35 c.c. of the U.S.P. test-solution of potassium hydroxide; finally dilute to 100 c.c."

I have found this method to yield fairly uniform brown colored solutions but not entirely of the same tint as that obtained by the Stevens method. The Menge process is the color reaction of glucose with potassium hydroxide which is well-known under the name of Heller's or Mohr's Test when applied as a qualitative test in the examination of urine. The color is produced by glucose and not by caramel and it is entirely an arbitrary standard as applied to standardizing of caramel solutions.

F. A. Upsher Smith (AMERICAN JOURNAL OF PHARMACY—September, 1911—411) recommends a process for standardizing caramel by comparison with an arbitrary standard consisting of a Nesslerized solution of ammonia, using a standard solution of ammonium oxalate to which 2 c.c. Nessler's solution is added as the arbitrary standard fixed for comparison. Here again we are comparing caramel with another coloring which is dissimilar.

From the writer's experiments he has become convinced that the preparations of caramel should be standardized against the caramel color itself and not against substitutes therefor as has been done in these proposed standard test solutions. This has led to the attempt to purify commercial caramel so as to isolate the coloring material and use this as a basis for a standard color solution to be used either as a coloring itself or to standardize commercial caramels. It was argued that if a purified caramel of fairly definite composition could be produced that standard solutions could then be made with but very slight variation that could be used for such purpose. Commercial caramels contain an uncertain quantity of unconverted sugar and probably traces of caramelan and experiments to produce a desiccated caramel by evaporation of a number of commercial samples yielded a hygroscopic material which could not be gotten into a sufficiently definite form to yield uniform results.

Experiments were then tried upon the precipitation of the caramel colorings by strong alcohol and as a result of a number of trials the following formula was evolved for a Purified Caramel:

PURIFIED CARAMEL.

Caramel	1000 gm.
Alcohol	3500 c.c.
Monohydrated Sodium Carbonate	4 gm.
Water	a sufficient quantity.

Weigh the Caramel in a capacious bottle or flask and add 250 c.c. of boiling water and thoroughly mix. Then gradually add 3000 c.c. of Alcohol shaking after each addition. Then set aside for six hours; decant the Alcohol on to a filter and wash the precipitated Caramel color with two portions of 250 c.c. each of Alcohol, decanting each time the Alcohol on to the filter. Drain the Alcohol thoroughly from the precipitate and dissolve it in 1500 c.c. of warm water. Add the Monohydrated Sodium Carbonate, filter the solution and evaporate it to the consistence of a thick syrup. Spread this upon sheets of glass or tin plates and when dry scrape off in scales the Purified Caramel and dry further in a desiccator over Sulphuric Acid for a day or until it ceases to lose weight.

In this process the alcohol dissolves out of the caramel, the unconverted sugar and the bitter and most of the odorous principles and only a small amount of the coloring. By distillation the alcohol can be recovered with but very little loss and used over again. The purified caramel so made is in dark brown, shining, translucent scales, free from bitterness and without any perceptible sweet taste and practically odorless. It is non-hygroscopic and dissolves readily and clearly in water and diluted alcohol. The yield averaged 37 per cent., and the purified caramel when compared in solution with the caramel from which it was made showed a tinctorial value of three times that of the latter. A sample of the purified caramel so made was exposed in an open vessel to the atmosphere during a rainy spell of two days when the air was charged with moisture, yet it remained in dry non-adhering scales which had absorbed but very little water and was readily dried by being placed for a short time in the desiccator. The addition of the small amount of sodium carbonate was found to be necessary as without it the purified caramel when once made and dried was not again entirely soluble in

water. This is readily understood from the preliminary explanation regarding the composition of commercial caramels.

Tincture of Caramel.—I submit the following for Tincture of Caramel:

TINCTURE OF CARAMEL.

Purified Caramel	50 gm.
Ammonia Water	10 c.c.
Water	740 c.c.
Alcohol	250 c.c.

Mix the liquids and dissolve the Purified Caramel in the mixture; filter if necessary.

Tincture of Caramel so made appears to be permanent and can be used either as a coloring or to standardize caramel solutions. One c.c. tincture diluted with 99 c.c. distilled water or better still 199 c.c. distilled water will form a comparative solution against which commercial caramels can be readily standardized.

It is to be noted that the formula proposed by the Committee for Tincture of Caramel was 10 per cent. of the caramel prepared in accordance with the formula given. The formula now submitted contains but 5 per cent. of the purified caramel, but as this is three times the strength of the commercial caramel the tincture resulting from this formula is very materially stronger than the formula first submitted to the Committee. If 5 per cent. be considered too strong then it can be reduced to 2. per cent. or to such strength as may be agreed upon.

THE NAMING OF CARBON COMPOUNDS.

A Dictionary of the Prefixes, Suffixes and other Syllables as well as Letters and Signs Used in the Naming of Carbon Compounds.

By

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(Continued from page 119)

I

i An abbreviation of *inactive* (which see).

ic The suffix *ic* is applied to the name of organic compounds in the adjective sense with the general meaning "pertaining to" or "like," the nominative being indicated by the preceding syllables, thus *tartar-ic*.

Iota, the ninth letter of the Greek alphabet (see Appendix H).

id See *amid, olid, anilid,* etc.

ide The same as *id*.

imid Indicates compounds containing the group $(=NH)''$, thus

$$\left.\begin{array}{l} CH_2.CO \\ | \\ CH_2.CO \end{array}\right> NH$$ is *butanimid.*

in See *ine*.

indo A prefix used to indicate relation to, or derivation from, indigo, thus *indole* is a basic compound derived from indigo. It is often used to refer to an indigo-like color, that is, blue, thus the *indolins* are a group of blue dye-stuffs.

ine (a) The ending *in* or *ine* indicates the unsaturated group $(—C \equiv C—)''$, in which two carbon atoms appear to be trebly bound, thus CH:CH is *ethine*, CH_3.C:CH is *propine* (see Appendix C–b). (b) In naming the proximate principles of plants the ending *ine* is generally confined by American writers to basic compounds (alkaloids, etc.), thus *atropine, morphine, strychnine,* while the ending *in* is applied to certain active constituents of

plants which are neutral or non-alkaloidal, thus *aloin, emodin,* etc. It is also used for *glycerides, glucosides,* bitter principles and proteids. (c) In many common names such as glycerin or glycerine, naphthalin or naphthaline the ending has no significance.

ino A suffix used in connection with names indicating the following groups, $(NH_2)'$, $(NHR)'$, $(NR_2)'$, $(NH)''$, $(NR)''$. Thus $NH_2CH_2.CH_2.COOH$ is called am*ino*propionic acid and not *amidopropionic acid.* See also *amido* and *amino.*

iod The prefix *iod,* often written *iodo* for the sake of euphony, is used to indicate the presence of iodine atoms (univalent iodine) in carbon compounds, thus iodo-benzene, C_6H_5I, is benzene in which one hydrogen atom has been replaced by iodine and *triiodomethane* is CHI_3.

iodo The prefix *iodo* is used to indicate the element iodine (see *iod*). The term is also used to indicate the group $—IO_2$ (see *iodoxy*).

iodoso The monovalent radical $(-I=O)'$, thus C_6H_5IO is *iodosobenzene.*

iodoxy The monovalent radical $\left(-I\begin{smallmatrix}\nearrow O\\ \searrow O\end{smallmatrix}\right)'$, thus $C_6H_5IO_2$ is *iodoxybenzene.* See also *iodo.*

iso When a hydrocarbon contains a branched chain, that is, contains a carbon atom which is combined with more than two other carbon atoms, it is often distinguished from the isomeric *normal* (which see) hydrocarbon by the prefix *iso;* thus $CH_3.CH_2.CH_2.CH_2.CH_3$ is normal pentane and $CH_3.CH(CH_3)CH_2.CH_3$ is called *isopentane.*

isocyanate The monovalent radical $(.O.N:C)'$, thus *potassium isocyanate* is KONC.

isocyanide The monovalent radical $(.N:C)'$, thus *ethyl isocyanide* is $C_2H_5.NC$. See also *isonitrile.*

isonitrile Organic isocyanides (see *isocyanide*) are commonly called isonitriles, thus $(C_6H_5)NC$ is called *phenyl isonitrile.*

ium Just as the names of basic elements end in *ium,* thus *sodium, potassium, calcium,* and the basic group $(NH_4)'$ is called *ammonium,* so in the naming of organic compounds the ending, *ium,* denotes basic compounds. See *oxonium, sulphonium.* Similar carbon or *carbonium* compounds, iodin or *iodonium* compounds

and even chlorin or *chloronium* compounds are known. It has been proposed to give this ending to the vegetable bases of alkaloids, thus *morphium sulphate, atropium hydrochloride,* etc.

K

κ Kappa, the tenth letter of the Greek alphabet (see Appendix H).

kacodyl The same as *cacodyl* (which see).

kata See Appendix J–e.

keto Indicates a *ketone* (which see), thus a ketohexose is a hexose containing a ketone group.

ketone Compounds containing the group $=C=O$ combined with two hydrocarbon radicals are called ketones, thus $CH_3.CO.CH_3$ is *dimethyl-ketone* (see *one*).

L

l An abbreviation for laevo (which see).

λ Lambda, the eleventh letter of the Greek alphabet (see Appendix H).

lact The syllable denotes derivation from milk; thus *lactose* is milk sugar, *lactic acid* is an acid obtained from milk, etc.

lactone A name applied to a class of compounds derived from alcohol acids by the elimination of water, thus $CH_2OH.CH_2.CH_2.COOH = H_2O + CH_2.CH_2.CH_2.CO$ (see *olid*).

lactyl The monovalent radical $CH_3.CHOH.CO'$ derived from lactic acid $CH_3.CHOH.COOH$. Thus *lactylphenetidin* is $C_6H_4.(OC_2H_5)(CH_3.CHOH).CO$.

laevo An abbreviation for *laevorotatory,* indicating that a substance deflects polarized light to the left.

M

m An abbreviation of *meta* (which see).

μ Mu, the twelfth letter of the Greek alphabet (see Appendix H).

malonyl The divalent radical $(.OC.CH_2.CO.)''$ derived from propanedioic or malonic acid, $COOH.CH_2.COOH$. Thus the hypnotic diethyl-barbituric acid is also called *malonyl urea* because it contains the malonyl radical in combination with urea.

Me Used in chemical formulas to represent the methyl group;

thus $CH_3.CH_2.CH(CH_3).CH_3$ is also written $CH_3.CH_2.CHMe.$-CH_3.

menthyl The monovalent radical $(C_{10}H_{19})'$ derived from menthol $C_{10}H_{19}OH$. Thus *menthyl-isovalerate* is $CH_3.CH(CH_3).CH_2.$-$CO.O.(C_{10}H_{19})'$.

mercaptan The same as *mercaptol* (which see).

mercaptol Synonymous with *thiol* (which see).

meso Meaning inactive or without effect on polarized light, thus *mesotartaric acid.*

meta The prefix *meta* or *m* is used to designate the 1 : 3 position in di-derivatives of benzene, thus 1, 3-dibrombenzene is also called *metadibrombenzene* (see Appendix B–).

meth The prefix denotes that a compound contains only one carbon atom, *methane* is CH_4, *methyl* is $(CH_3)'$, *methanol* is CH_3OH, etc.

metho Indicates the group $(CH_3)'$ if it be a branch of a side-chain (see Appendix A).

methoxy See *methoxyl.*

methoxyl The group $(—O—CH_3)'$, obtained by substituting methyl for the H in a hydroxyl group. It may also be considered as derived from methyl alcohol CH_3OH by elimination of the hydrogen of its hydroxyl.

methyl The monovalent radical $(CH_3)'$.

methylene The divalent radical $(CH_2)''$, this di-iodomethane; CH_2I_2 is also called *methylene iodide.*

mi The prefix has been proposed as a substitute for "meta," thus *miazine* for meta-azine (see *diazine*).

monatomic Alcohols and phenols containing one hydroxyl group are said to be *monatomic,* thus ethyl alcohol, C_2H_5OH, phenol C_6H_5OH, etc.

mono A prefix meaning one, thus C_2H_5Br is *mono-brom-ethane.*

N

n An abbreviation for *normal* (which see).

ν Nu, the thirteenth letter of the Greek alphabet (see Appendix H).

naphthyl The monovalent group $(C_{10}H_7)'$ derived from naphthalene $C_{10}H_8$, by elimination of a hydrogen atom or from naphthol, $C_{10}H_7OH$, by loss of the hydroxyl group.

nitrile The organic cyanides are preferably called nitriles, thus

CH_3CN is called *ethane nitrile,* or *acetonitrile* (see *acet* or *aceto*).

nitro A prefix indicating the group$(—NO_2)'$, derived from nitric acid by abstracting OH, thus *nitro-ethane,* $C_2H_5NO_2$, *nitro-benzene,* $C_6H_5NO_2$. Glycerine trinitrate, $C_3H_5(NO_3)_3$ is wrongly often called *nitroglycerine.*

nitroso Compounds containing groups with trivalent nitrogen are in general spoken of as *nitroso-compounds.* It is used in particular as a prefix to compounds containing the group $(C.N:O)'$, thus *nitrosobenzene* is C_6H_5NO.

nitrosyl The group $(.N:O)'$ used particularly when the group NO has replaced the hydrogen of a carboxyl group, thus *nitrosyl-benzoate* is $C_6H_5COO(NO)$.

non The prefix non- and nono-, derived from *nonus,* is commonly used to indicate the numeral nine. Thus the hydrocarbon C_9H_{20} is called *nonane.* The hydrocarbon C_9H_{18} is called *nonene,* etc.

nono Signifying nine (see *non*).

nonyl The monovalent radical C_9H_{19} derived from nonane C_9H_{20}.

normal Aliphatic hydrocarbons in which no carbon atom is combined with more than two other carbon atoms are said to be normal, thus $CH_3.CH_2.CH_2.CH_2.CH_3$, is *normal pentane* (compare *iso*). The term "normal" is also applied to salts which are formed from acids and bases in such a way that no acidic hydrogen of the acid remains nor any of the basic hydroxyl of the base. Normal salts are not always neutral to indicators, thus *normal sodium carbonate* when dissolved in water yields a solution which is strongly alkaline towards litmus.

numbers See numerals.

numerals For the use of numerals in indicating the position of groups or side-chains see Appendix B.

O

o Abbreviation for *ortho* (which see).

ω Omega, the twenty-fourth (last) letter of the Greek alphabet (see Appendix H).

o Omicron, the fifteenth letter of the Greek alphabet (see Appendix H).

oct The prefixes *oct, octa, octi* and *octo* derived from *octus,* are commonly used to indicate the numeral eight. Thus the hydrocarbon C_8H_{18} is called *octane,* while an alcohol derived there-

from and containing eight hydroxyl radicals would be called *octaneoctol.*

oi The prefix has been proposed as a substitute for *ortho,* thus *oizine* instead of ortho-azine (see *diazine*).

oic See Appendix G.

ol A suffix indicating hydroxyl, the $(OH)'$ group; thus CH_3OH is *methanol.* See Appendix D. The ending has also been applied to bodies which do not contain hydroxyl, thus *indol, skatol, pyrrol* and even *benzol, toluol, xylol* (see *ole*).

ole In the case of words which end in *ol* but do not contain a hydroxyl group it is proposed to change the ending to *ole,* particularly when they are basic in character (compare use of *ine* as an ending for basic compounds); thus *indole, skatole, pyrrole.*

olid The ending is given to anhydrides of alcohol-acids (alcohol anhydrides) or *lactones* (which see). Greek letters or numerals are used to indicate the relative position of the carboxyl group and the carbon atom combined with the alcoholic oxygen, thus $CH_3.CH.CH_2.CH_2.CO$ is *pentanolid* (1:4).
O

one The syllable indicates the ketone group ($R'.CO.R'$, thus *propanone* or *acetone* is $CH_3.CO.CH_3$ (see Appendix F). Also compare *sulphone.*

one For significance of 1 see Appendix B.

ortho The prefix *ortho* or *o* is used to indicate the 1:2 position of derivatives of benzene compounds (see Appendix B–c). In the naming of inorganic acids the prefix "ortho" is given to that acid of a given series which contains the greatest possible number of hydroxyl groups, thus of the three acids derived from phosphorous pentoxide H_3PO_4 or $PO(OH)_3$ is called *orthophosphoric acid.* In accordance with this, compounds considered as derived from a hypothetical ortho-carbonic acid $C(OH)_4$ are called compounds of orthocarbonic acid; thus $C(OC_2H_5)_4$ is called *orthocarbonic acid ethyl ester* or *ethyl orthocarbonate.*

osazone Osazones are compounds formed by the condensation of two molecules of a hydrazine with a di-aldehyde, di-ketone or aldehyde-ketone or with a ketone-alcohol or an aldehyde-alcohol. In the case of aldehyde-alcohols or ketone-alcohols the alcohol

group adjacent to the carbonyl group becomes oxidized to a carbonyl group before reacting with the hydrazine. From glucose and phenylhydrazine the *osazone* forms, thus: $CH_2.OH$.-$CHOH.CHOH.CHOH.CHOH.CHO + C_6H_5NH.NH_2 = CH_2$-$OH.CHOH.CHOH.CHOH.C(C_6H_5NH.N:)CH(C_6H_5NH.N:) + 2H_2O$.

ose The ending *ose* generally indicates a sugar, thus *lactose, glucose, fructose, sucrose,* etc. In such words as proteose, albumose, the ending "ose" is used to suggest relationship to parent bodies, *i.e.,* in the illustration given to albumin and protein.

oxalyl The divalent group $(.O:O.O:O.)''$ derived from oxalic acid, $(HO)OC.CO(OH)$.

oxime Compounds containing the group $(=N-OH)''$, thus $CH_3.C(N.OH)CH_3$ is *propanoxime* (2), $CH_3.CH_2.CH:N.OH$ is *propanoxime* (1). When obtained from aldehydes, CH_3.-$CHO + NH_2OH = CH_3.CH(:N.OH) + H_2O$, they are often called *aldoximes;* when from ketones $CH_3.CO.CH_3 + NH_2$-$CH_3.C(N.OH)CH_3$ is *propanoxime* (2), $CH_3.CH_2.CH:N.OH$

oxonium Oxonium compounds are bodies containing tetravalent basic oxygen, showing some analogy to ammonium salts, whence the name.

oxy Indicates an oxide, thus ether (common or ethyl ether), $CH_3CH_2.OCH_2CH_3$, is *ethane-oxy-ethane.* Unfortunately, in the past "oxy" has commonly been used in place of *hydroxy* (which see); thus phenol is called *oxy-benzene,* resorcinol or phendiol is called *dioxybenzene,* etc. In general the term *oxy* is used to indicate oxygen content in radicals or compounds. Thus, while the radical $(C_2H_5)'$, considered as derived from ethan, C_2H_6, by loss of hydrogen or from ethanol, C_2H_5OH, by loss of hydroxyl, the radical $(C_2H_5O)'$ is called *ethoxy.* Again, while the radicals $(C_6H_5C)'''$ and $(C_6H_5CO)'$, derived from benzoic acid, C_6H_5COOH, are termed *benzo* and *benzoyl,* respectively, the radical $(C_6H_5COO)'$ is called *benzoxy* (which see).

oyl The ending *oyl* is given to radicals obtained by abstracting hydroxyl from the carboxyl group of organic acids, thus CH_3.-$COOH = (OH)' + (CH_3.CO)'$, *ethanoyl;* $C_6H_5COOH = (OH)' + (C_6H_5CO)'$, *benzoyl.*

P

p An abbreviation for *para* (which see).

Phi, the twenty-first letter of the Greek alphabet (see Appendix H).

π Pi, the sixteenth letter of the Greek alphabet (see Appendix H).

ψ Psi, the twenty-third letter of the Greek alphabet (see Appendix H).

para The 1 : 4 position in benzene derivatives (see Appendix B–c); thus 1, 4-dichlorbenzene is also called *para-dichlorbenzene.*

pent *Pent, penta, pentyl,* prefixes derived from *penta,* meaning five, thus *pentane* is C_5H_{12}, *pentene* is C_5H_{10}, *pentyleoxide* is $C_5H_{10}O$.

penta See *pent.*

pentyl See *pent.*

per A prefix signifying the higher degree of valence in two similar compounds. See *peroxide.*

peri The 1 : 8 position in di-derivatives of naphthalene (see Appendix J–d).

peroxide A name assigned to any substance which yields hydrogen peroxide as one of the products of its decomposition. *Disuccinyl peroxide* is $COOH.CH_2.CH_2.CO.O.O.CO.CH_2.CH_2.COOH$.

Ph Used to indicate the phenyl group, C_6H_5, in formulas; thus $PhNH_2$ is aniline ($C_6H_5NH_2$).

phen The prefix is commonly used to indicate derivation from or relation to phenol, thus *phenol, phendiol, phentriol,* etc. It has been proposed to apply the name *phen* to benzene, C_6H_6, and to indicate all benzene derivatives by this prefix.

phenacyl The monovalent radical $C_6H_5.CO.CH_2$ — derived from aceto-phenone.

phenazine Phenazine is a name proposed for bi-cyclic compounds composed of an azine ring attached to a benzene ring.

phenetidin Amino-ethoxy-benzene, $C_6H_4(NH_2)(O.C_2H_5)$.

phenetol Phenol-ethyl-ether, benzene-oxy-ethane or ethoxy-benzene, $C_6H_5.O.C_2H_5$.

phenolsulphonate A salt derived from phenolsulphonic acid (see *sulpho*).

phenoxy The group $(C_6H_5O)'$. It may be considered as a *hydroxy* group, OH, in which a phenyl group, C_6H_5, has replaced the hyrogen.

phenyl The monovalent radical $(C_6H_5)'$ derived from phenol, C_6H_5OH.

phthal The syllable is used to indicate derivation from, or relation to, benzene-ortho-dicarboxylic acid, $C_6H_4(COOH)_2$ 1 : 2, which is commonly called *phthalic acid.* Thus *phenolphthalein* is a compound produced by the interaction of phenol and *phthalic anhydride.*

phthalyl A prefix denoting derivation from, or relation to, phthalic acid. Thus the alcohol, $C_6H_4(CH_2OH)_2$ 1 : 2, commonly called *phthalyl-alcohol.*

pi A prefix proposed as a substitute for *para,* thus *piazine* for para-azine (see *diazine*).

Pr In the writing of chemical formulas it has been proposed to indicate the propyl group $(C_3H_7)'$ by Pr, thus PrOH is *propyl-alcohol* $(CH_3.CH_2.CH_2.OH)$.

primary See Appendix D–b.

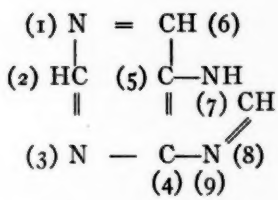
propyl The univalent radical $(C_3H_7)'$ derived from propane C_3H_8 by elimination of hydrogen or from propanol C_3H_7OH by abstraction of hydroxyl.

prop The prefix indicates C_3, thus *propane* is C_3H_8, *propene* is C_3H_6, etc.

pros See Appendix J–e.

pseudo The prefix derived from the Greek, ψευςής, meaning false, is applied in chemistry to compounds which similate or are closely related to others. Thus while isopropyl benzene is called cumene, its isomeric compound, trimethyl benzene, is called *pseudo-cumene.*

purin The purin nucleus is contained in such substances as caffeine, theobromine, xanthine, uric acid, etc. To indicate the position of groups, etc., the atoms of the purin nucleus are numbered thus:



Py An abbreviation of pyridine. For its use in the naming of quinoline derivatives see Appendix I.

pyro A prefix used to denote derivation from; often used to show that heat has been used in obtaining the substance, thus 1, 2-phendiol, is commonly called *pyrocatechin* because it was first obtained from catechu by dry distillation.

Q

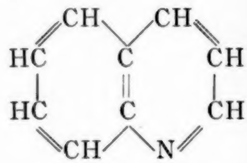
quart An abbreviation for *quarternary* (which see).

quarternary Four or fourth, thus quarternary amines are considered derived from ammonium hydroxide by replacement of all four hydrogen atoms, thus H_4NOH yields $(CH_3)_4NOH$.

quino A term used to indicate relation to, or derivation from (a) quinoline, (b) quinone and (c) quinine.

quinolin See *quinoline.*

quinoline A basic compound having the formula C_9H_7N and to which the following structure is commonly assigned:



For the methods of indicating the position of side-chains see Appendix I.

quinqui A prefix indicating five.

R

r An abbreviation for "ring," thus cyclo-propane, CH_2—CH_2, is also called *r-propane.*

ρ Rho, the seventeenth letter of the Greek alphabet (see Appendix H).

S

s An abbreviation for *symmetrical* (which see).

σ, ς Sigma, the eighteenth letter of the Greek alphabet (see Appendix H). The second form (ς) is not used in chemical nomenclature.

santalyl The radical $(C_{15}H_{23})'$ derived from ***santalol,*** $C_{15}H_{23}OH$.
secondary See Appendix D–b.
six For the use of the number 6 see Appendix B.
succinyl The divalent group $(.OC.CH_2.CH_2.CO.)''$ derived from succinic acid, $COOH.CH_2.CH_2.COOH$.
sulf The same as *sulph* (which see).
sulph Indicating sulphur, thus ***sulphone, sulphonic acid,*** etc.
sulphamide Compounds derived from sulphonic acids by replacing OH by NH_2, thus the amide of benzene-sulphonic acid is also called *benzene sulphamide.*
sulphanilate A salt or compound of *sulphanilic acid,* $SO_2(C_6H_4\text{-}NH_2)(OH)$ derived from sulphuric acid, $SO_2(OH)_2$ by replacement of a hydroxyl group by an aniline group $(C_6H_4NH_2)'$.
sulphide The organic sulphides, also called ***sulphur ethers,*** are compounds derived from H_2S by replacement of hydrogen by organic radicals, thus ***ethyl sulphide*** is $(C_2H_5)_2S$.
sulphimide An *imide* (which see) derivative of a sulphonic acid, thus saccharine is the *imide* of *o-sulphobenzoic acid.*
sulphinide Sulphinic acids contain the group — SO_2H. An imide derived from sulphonic acids is sometimes called sulphinide, thus saccharine is official as *benzosulphinide.*
sulpho A term used to indicate the presence of sulphur in compounds in general (see *sulphocyanide, sulphocarbolate*). Also used to indicate sulphonic acid derivatives, thus benzensulphonic acid is also called sulphobenzoic acid and phenol-sulphonic acid derivatives are known also as *sulphocarbolates.*
sulphocarbolate Formerly used instead of *phenolsulphonate* (which see).
sulphocyanate The same as *thiocyanide* (which see).
sulphocyanide The same as *thiocyanide* (which see).
sulphone Sulphones are compounds containing the group $(SO_2)''$, thus *diethyl-sulphone* $(C_2H_5)_2SO_2$.
sulphonic acid Compounds containing the group $(SO_2.OH)'$ derived from sulphuric acid, $OH.SO_2.OH$, by abstraction of $(OH)'$, thus *phenolsulphonic acid* is $C_6H_4(OH)(SO_2.OH)$.
sulphonium Basic compounds of sulphur in which tetravalent sulphur is combined with three alkyl groups and one hydroxyl group, the latter reacting with acids to form salts, thus *triethyl-sulphonium-hydroxide* $(C_2H_5)_3S.OH$.
sym An abbreviation for *symmetrical* (which see).

symmetrical 1, 3, 5-tri-derivatives of benzene are said to be symmetrical; thus *1, 3, 5-trichlorbenzene* (see Appendix B–c).

syn A prefix referring to stereoisomerism, meaning *together,* as opposed to *anti* (which see). The prefix *syn* has also been proposed to indicate the *neighboring* or *vicinal* position in the arrangement of side-chains of the atoms in a heterocyclic compound, thus 1, 2-ortho- or oi-diazine are called *syndiazines.*

T

τ Tau, the nineteenth letter of the Greek alphabet (see Appendix H).

θ, ϑ Theta, the ninth letter of the Greek alphabet (see Appendix H).

tautomer A name applied to bodies which may exist in two forms which are structurally different. In most cases tautomeric substances exist in ketone form ($R.CO.CH_2$) and "enol" form (unsaturated alcohol) ($R.C.(OH):CH.$).

terp The prefix usually denotes derivation from or relation to the hydrocarbon contained in turpentine (see Appendix K).

tetra *Tetra, tetryl,* prefixes derived from *tetra,* meaning four; thus *tetrachlorethane* is $C_2H_2Cl_4$, *tetrylinetriamine* is $C_4H_{11}N_3$.

tetryl See *tetra.*

thial Thio + al, sulphur aldehyde. Aldehydes in which the oxygen of the aldehyde group is replaced by sulphur, thus $CH_3.C\begin{smallmatrix}\diagup H\\ \diagdown S\end{smallmatrix}$ is *ethane-thial.*

thio Denotes sulphur. See *thial, thiol,* etc.

thiocyanide The monovalent radical $(.S.C:N)'$, thus $C_2H_5.S.C:N$ is *ethyl thiocyanide.* Also called *sulphocyanide* and *sulphocyanate.*

thiol Thio + ol, a sulphur alcohol. Compounds in which the oxygen of the alcohol group is replaced by sulphur, thus *ethanethiol* is $CH_3.CH_2.SH$.

thione Thi(o) + one, a sulphur ketone. Ketone in which sulphur replaces the oxygen of the ketone group, thus $CH_3.CS.CH_3$ is *propane-thione.*

thionyl The divalent radical $(SO)''$. Thus *thionylaniline* is $C_6H_5.N:SO$.

three For use of the figure 3 see Appendix B.

toluol Toluol has in the past been used occasionally as a synonym for toluene.

toluyl The monovalent radical $(CH_3.C_6H_4)'$ derived from toluene (methyl-benzene) $C_6H_5.CH_3$.

tolyl Meaning the same as *toluyl* (which see).

tri A prefix meaning three; thus chloroform $CHCl_3$ is called *tri-chlor-methane.*

triatomic Alcohols and phenols containing three hydroxyl groups are said to be triatomic, thus pyrogallol (1, 2, 3-phentriol) is a *triatomic phenol.*

triazine An *azine* (which see) containing three nitrogen atoms, that is, consisting of three carbon atoms and three nitrogen atoms united in a "ring" by nine "bonds."

two For the significance of the figure 2 see Appendix B.

U

υ Upsilon, the twentieth letter of the Greek alphabet (see Appendix H).

V

v An abbreviation of *vicinal* (which see).

valeryl The monovalent radical $(C_4H_9CO)'$ derived from valeric acid C_4H_9COOH.

vicinal 1, 2, 3-tri-derivatives of benzene; thus 1, 2, 3-trichlor-benzene is also called *vicinal-tri-chlorbenzene* (see Appendix B–c).

vinyl A name sometimes applied to *ethenyl* (which see); thus $CH_2 : CHOH$, ethenol, also called *vinyl alcohol.*

X

ξ Zeta, the sixth letter of the Greek alphabet (see Appendix H).

xanthine For the naming of xanthine derivatives see *purin.*

xylol Sometimes used as a synonym for *xylene.*

xylyl A prefix used to designate derivation from xylene (dimethyl-benzene), $CH_3.C_6H_4.CH_3$. It is particularly applied to the monovalent radical $CH_3.C_6H_4.CH_2'$; thus $CH_3.C_6H_4.CH_2Cl$ is called *xylyl-chloride.*

Y

yl The ending *yl* is characteristic of many radicals, thus *methyl, ethyl, benzoyl,* etc. (which see).

ylal The ending *ylal* is used to indicate aldehyde radicals in which the aldehyde group is retained, thus *ethylal.*

ylol The ending *ylol* is given to alcohol radicals in which OH is retained, thus *ethylol.*

APPENDIX.

A. According to the rules adopted by a congress of chemists, held in Geneva, Switzerland, in 1902 (*American Chemical Journal,* vol. 15, p. 50. Berichte der deutschen chemischen Gesellschaft, vol. 26, p. 1595) the names of the saturated hydrocarbons, that is compounds of carbon and hydrogen in which the carbon atoms are united by single bonds or valencies only and which therefore contain no unsaturated valencies (double or treble bonds), end in "ane" (in the German language the final e in this, and in similar endings, is dropped and the ending is "an"). The first four hydrocarbons, CH_4, $CH_3.CH_3$, $CH_3.CH_2.CH_3$, $CH_3.CH_2.CH_2.CH_3$ are called methane, ethane, propane, butane; also $\begin{array}{c} CH_2—CH_2 \\ \diagdown\ \diagup \\ CH_2 \end{array}$ is cyclo-propane and $\begin{array}{c} CH_2.CH_2 \\ | \quad\ | \\ CH_2.CH_2 \end{array}$ or $\begin{array}{c} CH_2.CH_2 \\ \vdots \quad\ \vdots \\ CH_2.CH_2 \end{array}$ is cyclo-butane.

All other saturated hydrocarbons if normal, that is if no carbon atom is combined with more than two other carbon atoms, are named by indicating the number of carbon atoms by a prefix derived from the Greek numerals and adding the suffix "ane," thus C_5H_{12}, C_6H_{14}, C_7H_{16}, C_4H_{48}, C_9H_{20}, $C_{20}H_{22}$ are called pentane, hexane, heptane, octane, nonane, decane respectively.

The hydrocarbons which are not normal but contain a carbon atom combined with more than two other carbon atoms, *i.e.,* are branched chains, derive their names from the longest normal chain contained in them and the side-chains are indicated by prefixes, ending in "yl," thus:

$$\begin{array}{l} CH_3.\dot{C}H_2.CH_3 \\ \quad\ \ CH_3 \end{array} \text{ is methyl-propane}$$

$$\begin{array}{l} CH_3.CH_2.\dot{C}H_2.CH_2.CH_3 \\ \qquad\quad\ CH_2.CH_3 \end{array} \text{ is ethyl-pentane}$$

If the side-chain also is branched, the branches are given these endings "o" instead of "yl," thus:

$CH_3.CH_2.CH_2.CH_2.CH_3$
$\quad\dot{C}H_2.CH_3$ is metho-ethyl-pentane.
$\quad\dot{C}H_3$

B. (a) To indicate the point of attachment of side-chains the carbon atoms of the main chain are numbered beginning at the end nearest the side-chain and the number of the carbon atom to which the side-chain is attached added to the side chain. If there are two side-chains equally distant from the ends then the numbering is begun at the end nearest the smaller side-chain, thus:

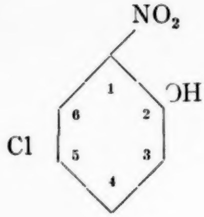
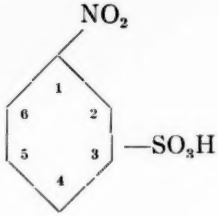
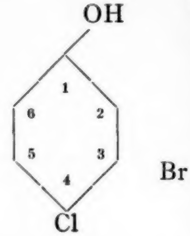
1 2 3 4 5
$CH_3.CH_2.CH_2.CH_2.CH_3$ is 2-methyl-pentane or methyl(2)-pentane.
$\quad\dot{C}H_3$

1 2 3 4 5 6
$CH_3.CH_2.CH.CH.CH_2.CH_3$ is 2-methyl-3-ethyl-hexane
$\quad\dot{C}H_3.\dot{C}H_2$ or methyl(2)-ethyl(3)-hexane
$\quad\quad\dot{C}H_3$ or methyl-ethyl-hexane (2:3).

If it becomes necessary to number the carbon atoms of a side-chain then the numbers begin at the point of attachment and these numbers are added as indices to the number of the carbon atom of the main chain, thus:

1 2 3 4 5 6 7
$CH_3.CH.CH_2.CH.CH_2.CH_2.CH_3$
$\quad\dot{C}H_3 \quad 4^1\dot{C}H_2$ is 2-methyl-4^2chloro-4-ethyl-heptane.
$\quad\quad 4^2\dot{C}H_2Cl$

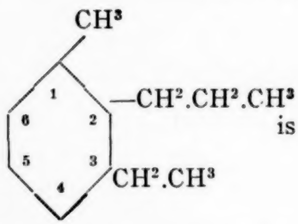
(b) The carbon atoms of the benzene ring are numbered 1 to 6 from left to right. In poly-substitution compounds of benzene the numbering begins at the carbon atom attached to the element having the smallest relative weight, or in case of two or more like atoms, to the group having the smallest relative weight, thus:

1.  2.  3. 

The names are then derived by giving the groups in the order of the increasing atomic weights of the atoms which link the group to the neucleus, and the above benzene compounds are called:

1. 1-nitro-2-hydroxy-5-chlorbenzene or nitro-hydroxy-chlorbenzene (1 : 2 : 5).
2. 1-nitro-3-sulphonic-acid-benzene or nitro-sulphonic-acid-benzene (1 : 3).
3. 1-hydroxy-4-chlor-3-brombenzene or hydroxy-chlor-brombenzene (1 : 4 : 3).

When two or more groups are attached to the benzene ring by like elements then the numbering begins at the carbon atom bearing the group which has the smallest weight and they are named in the order of their increasing weights, thus:



is 1-methyl-3-ethyl-2-propyl-benzene.

Many authors, thus Richter (Lexicon of Carbon Compounds) have not adopted the use of numbers to indicate the position of side-chains or radicals in open-chain compounds, but use them only for benzene derivatives and, for the open-chain compounds employ Greek letters, instead. Compare H, I, J and K (this Appendix).

(c) Instead of indicating the position of side-chain or substituents of benzene by numbering the carbon atoms and indicating by these numbers the carbon atoms to which each group is attached, other designations are in use, thus:

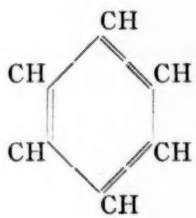
1, 2-dichlorbenzene is also called ortho-dichlorbenzene,
1, 3-dichlorbenzene is also called meta-dichlorbenzene,
1, 4-dichlorbenzene is also called para-dichlorbenzene,
1, 2, 3-trichlorbenzene is also called vicinal trichlorbenzene,
1, 3, 5-trichlorbenzene is also called symmetrical-trichlorbenzene,
1, 2, 4-trichlorbenzene is also called asymmetric-trichlorbenzene.

(d) A number, if in brackets, refers to the preceding element or group, otherwise to the element or group immediately following, thus 1-brombutene(2) is $CH_3CH:CH.CH_2Br$.

C. (a) According to the rules of the Geneva Congress open-chain unsaturated hydrocarbons containing a double bond are named by changing the ending "ane" of the corresponding saturated hydrocarbon to "ene." When two, three, etc., double bonds occur in such a compound then the ending becomes "diene," "triene," etc. The position of the double bond is indicated by the number of the first carbon atom participating in this double linkage, thus $CH_2:CH_2$ is called ethene and $CH_2:CH.CH_2.CH_2.CH:CH_2$ is called

6 5 4 3 2 1

hexa-1,5-diene. While the naming of cyclic compounds was not considered at this conference, it would naturally follow that benzene,



be called cyclo-hexatriene.

(b) According to the rules of the Geneva Congress, hydrocarbons containing a triple bond end in "ine" thus acetylene, $CH:CH$, should be called ethine and $CH:C.CH_2.CH_3.C:CH$ hexa-1, 5-diine.

6 5 4 3 2 1

D. (a) In accordance with the rules of the Geneva Congress the names of alcohols (and phenols) are derived by adding the suffix "ol" to the names of the hydrocarbons from which they are derived.

An alcohol containing two hydroxyl groups is a "diol," one containing three is a "triol," etc. Accordingly wood alcohol CH_3OH, is methanol, ordinary alcohol, $CH_3.CH_2OH$ is ethanol, glycerol (glycerin), $CH_2OH.CHOH.CH_2OH$ is propanetriol, the chief constituent of fusel oil $\left.\begin{matrix}CH_3\\CH_3\end{matrix}\right\rangle CH.CH_2.CH_2.OH$, is 3-methyl-butane-1-ol

$$\begin{matrix} 4 & 3 & 2 & 1 \end{matrix}$$

and the hypnotic known as amylene hydrate, $\begin{matrix} & CH_3 & & \\ & \vert & & \\ CH_3. & C & .CH_2. & CH_3 \\ 1 & 2 & 3 & 4 \\ & \vert & & \\ & OH & & \end{matrix}$ is 2-methyl-butane-2-ol.

(b) All alcohols may be considered as having been derived from methyl alcohol, CH_3OH, by replacement of one, two or three hydrogen atoms by hydrocarbon groups. According to the hydrogen atoms so replaced they contain the groups $—CH_2OH$, $=CHOH$ or $\equiv COH$. They are called primary, secondary and tertiary alcohols, thus butanol(1), $CH_3.CH_2.CH_2.CH_2OH$, is primary butyl alcohol; butanol(2), $CH_3.CH_2.CHOH.CH_3$, is secondary alcohol and methyl-(2)propanol(2), $\begin{matrix} & CH_3 & \\ & \vert & \\ CH_3. & C & .CH_3 \\ & \vert & \\ & OH & \end{matrix}$, is tertiary butyl alcohol.

(c) Sometimes the names of alcohols are derived by considering them derived from methyl alcohol, also called carbinol, thus butanol-(2), $CH_3.CH_2.CHOH.CH_3$ is called methyl-ethyl-carbinol and methyl(2)-propanol(2), $CH_3.C(CH_3)(OH).CH_3$, is called trimethyl-carbinol.

E. According to the rules of the Geneva Conference the names of aldehydes are formed by adding "al" to the corresponding hydrocarbon, thus formaldehyde, $HCHO$, is methanal and acetaldehyde, $CH_3.CHO$, is called ethanal.

F. For ketones the Geneva Congress adopted the ending "one," thus acetone, $CH_3.CO.CH_3$, is propanone and acetyl-acetone, CH_3.-$CO.CH_2.CO.CH_3$, is pentane-dione (2:4). Similarly the ending in menthone, carvone, irone, ionone shows that these bodies are ketones.

G. According to the rules of the Geneva Conference the aliphatic, or fatty, acids are named by adding "-oic acid" to the

name of the hydrocarbon from which they are derived. In indicating the position of side-chains the carbon atom of the carboxyl group is given the number 1, thus formic acid, HCOOH, is methanoic acid, acetic acid, CH_3COOH, is ethanoic acid, valeric acid, $CH_3.CH(CH_3).CH_2.COOH$, is 3-methyl-butanoic acid(1), lactic acid, $CH_3.CHOH.COOH$, is 2-hydroxy-propanoic acid or propan-2-olic acid. Since the carboxyl group in the last compound can be at the end carbon atom only, its position need not be indicated.

H. (a) While according to the rules of the Geneva Congress the position of side-chains or groups is indicated by numbering the carbon atoms of the main chain (see B in this Appendix) many chemists use numerals for cyclic compounds only and employ the letters of the Greek alphabet (see d below) for chain compounds; thus $\underset{\alpha}{CH_3}.\underset{\beta}{CH}(CH_3).\underset{\nu}{CH_2}.\underset{\varsigma}{CH_2}.\underset{\varepsilon}{CH_3}$ is β-methyl-pentane.

(b) The custom of indicating the position of radicals in hydroxyl-acids, amino-acids, etc., by lettering the carbon atoms, beginning at the carbon atom adjacent to the carboxyl group is somewhat confusing; thus $CH_3.\underset{\beta}{CH}OH.\underset{\alpha}{CO}OH$ is then called α-hydroxypropanoic acid and $\underset{\beta}{CH_2}OH.\underset{\alpha}{CH_2}.COOH$ is β-hydroxy-propanoic acid. The carbon atom at the end of a chain is often indicated by ω

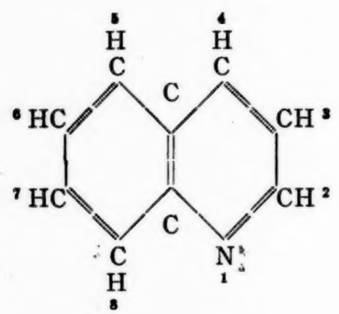
(c) The sign or lette Δ is also much used to denote double bonds, thus Δ_4-pentenoic acid denotes that in the 5-carbon ("pent") acid (oic acid) the double bond (ene) proceeds from the fourth carbon atom, thus $\underset{5}{CH_2}:\underset{4}{CH}.\underset{3}{CH_2}.\underset{2}{CH_2}.\underset{1}{COOH}$. Here it again is confusing that some authors begin the numbering, or lettering, at the end carbon atom while others give to the carbon atom adjacent to the carboxyl group the figure 1 or the letter α.

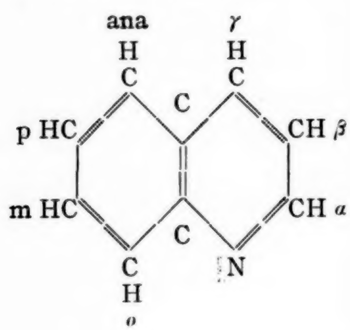
For the manner of indicating the position of side-chains in quinoline derivatives see in this Appendix I; for napthalene derivatives see in this Appendix J; for terpenes see in this Appendix K.

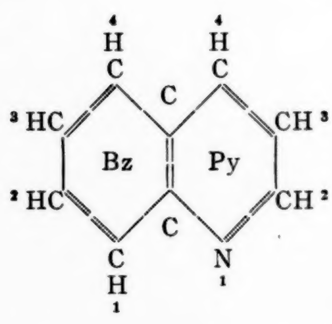
GREEK ALPHABET.

α	= Alpha	ι	= Iota	ρ	= Rho
β	= Beta	κ	= Kappa	σ, ς	= Sigma
γ	= Gamma	λ	= Lambda	τ	= Tau
Δ, δ	= Delta	μ	= Mu	υ	= Upsilon
ε	= Epsilon	ν	= Nu	φ	= Phi
ζ	= Zeta	ξ	= Xi	χ	= Chi
η	= Eta	o	= Omicron	ψ	= Psi
θ, ϑ	= Theta	π	= Pi	ω	= Omega

I. Three different methods of indicating the position of groups or side-chains in quinoline derivatives are in vogue. In reduced quinoline nuclei, a displacable hydrogen is also connected with the nitrogen atom, for which the position one (1) is reserved.







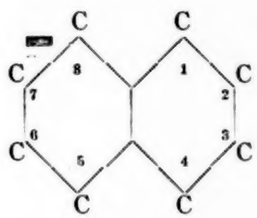
(a) Beginning at the nitrogen atom, the eight reactive atoms are numbered consecutively from left to right, and 8-hydroxy-quinoline, the sulphate of which is known as chinosol, means that

the OH has replaced the H at the carbon atom bearing the number 8.

(b) The carbon atoms of the pyridine portion of the molecule are lettered α, β, γ, etc., as indicated above, while the carbon atoms of the benzene portion of the molecule are designated o-, m-, p- and an (ana), as indicated above, and 8-hydroxyquinoline then becomes o-hydroxyquinoline.

(c) The pyridine part of the molecule is also indicated by Py- and beginning at the N atom, the atoms are numbered 1, 2, 3, 4, while the benzene portion of the molecule is indicated by Bz- and the carbon atoms are again numbered 1, 2, 3, 4 as indicated above. Then 8-hydroxyquinoline is designated as Bz-1-hydroxyquinoline.

J. (a) To indicate the point of attachment of substituents in naphthalene its carbon atoms are numbered thus:



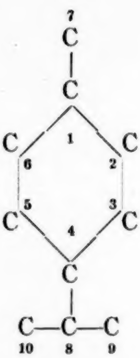
(b) The carbon atoms numbered 1, 4, 5, 8 are also designated "alpha" or "α" and those numbered 2, 3, 6, 7 as "beta" or "β," thus alpha-naphthol or α-naphthol and beta-naphthol or β-naphthol.

(c) Occasionally the terms "ortho," "meta" and "para" (see B, c in this Appendix) are used in naming bi-derivatives just as they are used in the naming of benzene derivatives.

(d) The prefix "peri-" is used to indicate the 1; 8-position in bi-derivatives of naphthalene, thus, 1, 8-naphthol-sulphonic acid, $C_{10}H_6(OH)(HSO_3)$, is also called peri-naphthol-sulphonic acid.

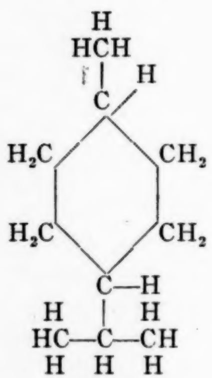
(e) Naphthalene derivatives having the 1, 5-position are called *ana*-derivatives, those in the 1, 6-position *epi-*, in the 1, 7-position *kata-*, in the 2, 6-position *amphi-*, and in the 2, 7-position *pros-* derivatives.

K. (a) Many of the terpenes, $C_{10}H_{16}$, are closely related to methyl-isopropyl-benzene: to indicate the position of substituents the following scheme of numbering the carbon atoms is used:

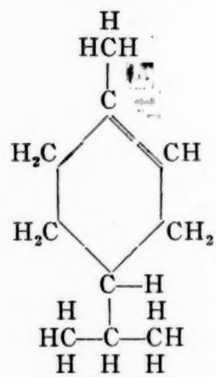


(b) The position of double unions is indicated by the sign "Δ" (see H, c in this Appendix); thus, if the double bonds are between 1:2 and 4:5 thus is indicated by Δ 1,4; if between 1:2 and 4:8 it is written Δ 1,4(8).

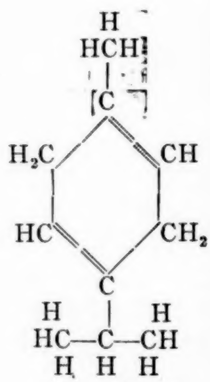
(c) It has been proposed that in the naming of these terpenes they be considered as derived from hexahydro-cymene, $C_6H_{10}(CH_3)$-(C_3H_7), and to call this substance terpane, the ending "ane" denoting that it contains no double or unsaturated unions. Then tetrahydro-cymene, containing one double bond, becomes terpene and dihydro-cymene is terpa-di-ene, thus:



Terpane.



Terpene.



Terpadiene.

Menthol, which is a monatomic alcohol of terpane, $C_6H_9(CH_3)$-(OH) (C_3H_7), 1:3:4 is then called *terpanol.* Terpin hydrate, which is a diatomic alcohol of terpane, containing one molecule of water of crystallization, is then called *terpanediol hydrate.*

LABORATORY OF THE AMERICAN MEDICAL ASSOCIATION.

THE FEBRUARY PHARMACEUTICAL MEETING.

The February Pharmaceutical meeting was held on Friday at 3 P. M. in the Materia Medica Lecture Room, Mr. William McIntyre in the chair. Dr. Adolph W. Miller spoke very entertainingly on "The Mythology of Trees." He said there are many interesting legends concerning trees. Men just emerging from barbarism usually venerate natural objects. During the warm pleasant days of summer, when food was plentiful, men basked in the sunshine and enjoyed themselves, but the cold dark days of winter brought great distress, this led men to worship the sun and fire as gods. Three classes of objects became to uncivilized men objects of worship; these were mountains, trees, and rivers. Primitive man as he walked the earth kept his eyes upon the ground in search of objects of food, as he elevated his eyes he beheld the high tree tops, or still higher mountains, or the broad rivers, so that these all became to him sacred, and this sanctity extended to parts of these objects, such as wood from the trees or stones from the mountains. A portion of the twin oak of Jupiter was said to have been given to Jason, leader of the Argonautic expedition, which he had built into the prow of his vessel. Our forefathers of Briton and Germany believed not only in the sanctity of the oak, but also of the ground underneath. They did not believe in temples built with men's hands. In the black pine forests of Northern Europe the silence was ordinarily most impressive, but at times was broken by the storm announcing the coming of the old Norse god, "Wodan." The oak was sacred to the nations of Northern Europe. Underneath its shade they held their religious and judicial meetings, but the oak was specially sacred when the mistletoe was found growing upon it. There is a legend of Baldur, son of Odin (Wodan), a sun god from whom a beautiful and bright light is said to have emanated, being killed by a sharpened twig of mistletoe thrown at random by the blind god Hodur. In modern times the mistletoe is regarded as a bearer of good tidings, especially at Christmas time when hung over head. It is said, however, to bring misfortune when cast under foot. A decoction of the mistletoe is used by some as a medicine. In the days of the Druids when the mistletoe was found growing upon an oak, it was cut by one of the priests with a golden knife, admist religious ceremonies.

Ancient nations believed that man originated from trees. There is a legend in the East that man and woman sprang from oak and elm logs that were found floating in the Persian Gulf. Some of the illustrious families of Greece derive their origin from trees. The ash tree was the tree of life to the ancient Germans. They also believed in the sacred apple tree, from which Juno was said to have given of the fruit of the tree to old men who were thus rejuvenated. The ancient Brahmans had also a sacred tree under which Buddha was said to have obtained sanctity and to have been tempted forty-nine days. It is called the *Ficus religiosum.* Pilgrimages are made to the sacred banyan tree in the Island of Ceylon. The sandal wood tree is greatly revered by the three great religions of the East. Frequently when a man of prominence dies, each of his friends sends a stick of sandal wood for building a funeral pyre upon which the body of the departed is cremated. The quality of the sandal wood is indicated by its color, the dark heart wood yielding the volatile oil. Beautiful carved work boxes are frequently made from sandal wood, the odor protecting the contents from destruction by the white ants. The olive tree in the East, especially among the Jews, is considered a symbol of peace. Dr. Miller also spoke of the Christian missionaries sent out from Rome who cut down the oak groves of the Druids, often amidst the curses of the people. At one time an oak broke in falling, and fell in the shape of the cross. This supposed miracle was the means of converting many to Christianity. Trees are still worshiped to some extent in Germany. At certain times of the year troops of the young people go out to the woods, half Christian and half heathen ceremonies being carried out. At the close of Dr. Miller's address, Dr. C. B. Lowe spoke of the invasion a number of years ago, of the apple orchards of Brittany France, by the mistletoe. The appearance of this parasite caused consternation among the peasants, as it threatened to greatly lessen their apple crop. It proved, however, to be a blessing in disguise, as the mistletoe which they gathered and shipped to England yielded a larger return than their apples had done. He also alluded to the gates, 11 feet high and 9 feet wide, of sandal wood, richly carved, which were once part of the temple of Somnath in Guzerat, once esteemed the holiest temple in India. They were captured and carried off to Afghanistan in 1025, where they remained until re-

captured by the English in 1842, when they were taken back to India. They are now preserved in the citadel of Agra.

A paper by Mr. John K. Thum, Ph.G., apothecary at the German Hospital, was then read. The title of the paper was "Note on Proposed Formula for Petrox." He seemed to prove conclusively that the proposed formula was not an improvement over that of the N. F. (See March issue AMERICAN JOURNAL OF PHARMACY.) Prof. Charles H. LaWall then spoke in an interesting manner of some of the imported drugs that had been sent to him for examination as a government chemist. He said that the government had had much trouble with Italian preparations on account of their extravagant claims and misstatements. One that had passed through his hands was Compound Syrup of Horseradish with Ferrous Iodide and Cinchona. The Italians are great users of effervescent granular salts, but they do not put exact labels on these preparations, simply labeling them as granular effervescent salts without specifying their exact composition, so that they can not be held for deficiency in strength. Some curious Chinese drugs were shown, some pills being the size of shellbarks, coated on the outside with a thick coating of wax, containing inside another pill coated with gold foil, each pill weighing half an ounce. Prof. LaWall stated that owing to the rigid inspection by the government authorities, there had been a great improvement in the quality of drugs, asafetida never yielding less than 40 per cent, of resin and sometimes 70 per cent. An importation of what was called cinchona sweepings, was found to contain 30 per cent. mineral matter and only yielded one per cent. of cinchona alkaloids. Cocabutong was found to be absinthe fortified with coca. A preparation brought to him by a gardener for analysis was found to be a 40 per cent. solution of nicotine in a fixed alkali. During the analysis he incinerated a weighed quantity to ascertain the ash. During the process he was so saturated with nicotine as to be unable to smoke a cigar for a week. Each time he tried it made him sick, like a beginner. After a vote of thanks to those who had furnished papers for the meeting, adjournment took place.

C. B. LOWE.

NOTES AND NEWS.

PROFESSOR JOSEPH P. REMINGTON, Dean of the Philadelphia College of Pharmacy, was tendered a dinner in commemoration of the sixty-fifth anniversary of his birth, by the members of the Philadelphia Drug Club, on Tuesday evening, March 26th. In addition to the members of the Drug Club there were also present the members of the faculty and officers of the Philadelphia College of Pharmacy and a number of the out-of-town friends of Professor Remington. Mr. George D. Feidt, President of the Drug Club, acted as Toastmaster and presented Professor Remington with a large bouquet of "American Beauty Roses." Mr. Joseph L. Lemberger made the principal address upon "Our Honored Guest." This was followed by a response by Professor Remington, who in a very happy address thanked the members of the Drug Club for this expression of their esteem and for their loyal support in all of his labors.

Numerous letters and telegrams were received from his friends in various parts of the United States, Cuba, and abroad, expressing their felicitations on the occasion, and some of these were read at the dinner. Various addresses were made, among which the following may be mentioned: President Howard B. French responded on behalf of the Philadelphia College of Pharmacy; Dr. S. Solis Cohen for the Medical Profession; Dr. Adolph W. Miller on behalf of the Wholesale Druggists; Mr. D. J. Reese for the Retail Druggists; Dr. John F. Hancock on behalf of the American Pharmaceutical Association; Professor Charles H. LaWall on behalf of the Pennsylvania Pharmaceutical Association; Mr. Milton C. Campbell for the Pharmaceutical and Chemical Manufacturers. Other addresses were made by Mr. D. E. Bransome; Mr. F. W. Fluck; Mr. Frank W. Smith; Mr. George W. Fehr; Mr. Otto Krause; Mr. W. L. Cliffe; Prof. Henry Kraemer; Mr. John N. G. Long; Mr. Harry P. Cassidy; Mr. Penrose Jones and Prof. H. C. Wood, Jr.